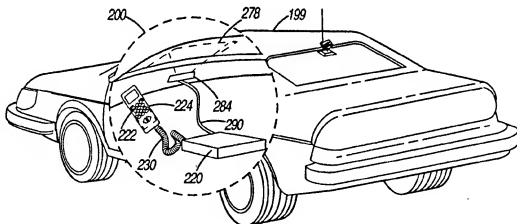


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵: H04M 11/00	A1	(11) International Publication Number: WO 95/03664 (43) International Publication Date: 2 February 1995 (02.02.95)
(21) International Application Number: PCT/US94/07011 (22) International Filing Date: 20 June 1994 (20.06.94) (30) Priority Data: 08/096,390 26 July 1993 (26.07.93) US (71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US). (72) Inventors: MEIDAN, Reuven; 30 Zalman Shneior, 47239 Ramat Hasharon (IL). RABE, Duane, C.; 2702 Millstone, Rolling Meadows, IL 60008 (US). ARIAV, Nathan; 4 Hagefen Street, 75203 Rishon LeZion (IL). ACHSAF, Hanan; 16 Rachvat Ilan, 51905 Givat Shmuel (IL). (74) Agents: PARMELEE, Steven, G. et al.; Motorola Inc., Intellectual Property Dept./IPC, 1303 East Algonquin Road, Schaumburg, IL 60196 (US).		(81) Designated States: BR, CA, CN, GB, JP, KR, RU. Published <i>With international search report.</i>

(54) Title: RADIO TRANSCEIVER WITH INTERFACE APPARATUS WHICH VISUALLY DISPLAYS INFORMATION AND METHOD THEREFOR

**(57) Abstract**

A mobile radiotelephone (100), and associated method, which facilitates usage thereof by a user while also operating an automotive vehicle (199). The radiotelephone includes a handset (222) having actuation keys (224) of unique geometries permitting the user to identify the keys by tactile rather than visual inspection. A visual-signal display assembly (772) comprised of a heads-up display, including a screen element (778) positionable at a front windshield assembly portion of an automotive vehicle, forms an output display of the radiotelephone, also to facilitate usage of the radiotelephone by a user while also operating the automotive vehicle (199).

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**RADIO TRANSCEIVER WITH INTERFACE APPARATUS
WHICH VISUALLY DISPLAYS INFORMATION
AND METHOD THEREFOR**

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Background of the Invention

10 The present invention relates generally to radio transceivers and, more particularly, to a radiotelephone, and associated method, operable in a cellular communication system which includes interface apparatus which facilitates usage of the radiotelephone by a user while the user performs additional tasks, such as operating a motor vehicle.

15 A communication system is comprised, at a minimum, of a transmitter and a receiver interconnected by a communication channel. A radio communication system comprises one type of communication system wherein the communication channel interconnecting the transmitter and the receiver is formed of a radio frequency channel. No fixed connection is required between the
20 transmitter and receiver of a radio communication system. Therefore, a radio communication system is advantageously utilized when a fixed connection between the transmitter and the receiver would be inconvenient or impractical.

25 A cellular communication system is one type of radio communication system. In a cellular communication system, numerous fixed-site transceivers, referred to as "base stations," are installed at spaced-apart locations throughout a geographical area. Each of the base stations contains circuitry to receive modulated signals transmitted thereto, and to transmit modulated signals
30 therefrom. A radiotelephone transmits the modulated signals to a base station, and a base station transmits the modulated signals to the radiotelephone. The modulated signals are transmitted upon selected frequency channels allocated for such cellular communications.

- 2 -

A plurality of radiotelephones may be operated simultaneously when the modulated signals transmitted by the different radiotelephones are transmitted upon dissimilar channels. The dissimilar channels may be defined, e.g., to be of dissimilar frequencies or to be of dissimilar transmission time periods upon a single range of frequencies. (The modulated signals transmitted by base stations to the radiotelephone are similarly transmitted upon dissimilar channels.) As the power levels of the modulated signals generated by both the radiotelephones and the base stations are relatively low, the same frequency channel may be reused throughout a geographical area to transmit the modulated signals between a radiotelephone and a base station. In such manner, a cellular communication system efficiently utilizes the channels of the frequency band allocated for such use.

Technological improvements have decreased the cost associated with communication in a cellular communication system. As a result, ever-increasing numbers of users are able to make use of a cellular communication system to communicate thereupon. Of particular popularity is the use of a radiotelephone to communicate in a cellular communication system when the user is traveling in an automotive vehicle. Radiotelephones constructed for installation within an automotive vehicle are conventionally referred to as mobile phones. As no fixed connection is required between the radiotelephone and a base station, communication is permitted therebetween as long as the vehicle in which the radiotelephone is positioned is within the geographical area encompassed by the cellular communication system.

The steps required to be taken to effectuate a communication link between a radiotelephone, such as a mobile phone, and a base station are quite similar to the steps required to be taken to effectuate communication when utilizing a telephone of a conventional, wireline, telephonic system. Namely, a telephone number is entered by a user by way of a telephonic keypad. An additional key is also actuated to cause transmission of the telephone number to the base

- 3 -

station. The telephone number is associated with a particular telephone situated at a remote location, and, once the telephone number is transmitted by the radiotelephone to a base station, effectuation of a communication link with the telephone situated at the remote location is accomplished in conventional manner.

Quite frequently, when the radiotelephone is positioned in an automotive vehicle, the user of the phone is also the operator of the vehicle. When operating the vehicle, primary attention must be directed to that task. Only minimal attention may be allocated to taking the steps required to effectuate communication in a cellular communication system. Although the required step of entering a telephone number is not, of itself, a complex task, visual inspection of the telephonic keypad is typically required of the user to ensure correct dialing of the telephone number. This visual inspection required to dial the telephone number detracts from the attention which must be directed to operating the automotive vehicle.

To minimize the visual inspection required to enter the telephone number, therefore, mobile phone constructions frequently include features to simplify the task of effectuating a communication link with a base station. For instance, the speaker and microphone, conventionally mounted upon a telephonic handset, are, in some mobile phone constructions, also fixedly mounted within the vehicular compartment of the automotive vehicle. Rather than holding a telephonic handset to position the speaker and microphone proximate to the user, the user may speak towards the microphone mounted in the fixed position in the vehicular compartment and listen to signals generated by the speaker similarly mounted in fixed position therein. Such feature is frequently referred to as a "hands-free" feature permitting "hands-free" operation of the mobile phone.

Additionally, existing mobile phone constructions frequently include features to reduce the number of steps necessary to dial a telephone number. Analogous to conventional, wireline telephonic constructions permitting "speed-dialing," mobile phone constructions include features permitting such dialing of a telephone

- 4 -

number. Conventionally, a switch is associated with a single telephone number, and, when the switch is actuated, the telephone number associated therewith is dialed. When appropriately positioned in the vehicular compartment of the automotive vehicle, the operator of the automotive vehicle, upon memorizing the location of the switch, can dial the telephone number associated therewith by actuation of the switch.

However, as the switch is associated with a single telephone number (i.e., there is a one-to-one correspondence between the switch and the telephone number), an increase in the number of telephone numbers which may be "speed-dialed" requires a corresponding increase in the number of switches. The location of each switch must be memorized to avoid the requirement of a user to inspect visually the location of the switch prior to actuation thereof. With each additional switch, the likelihood that the user, either as an impulse or as of necessity, must visually inspect the location of the switch prior to actuation thereof increases, as the user must both memorize the locations of the switches and the telephone numbers associated therewith to actuate a switch without first making a visual inspection of the location thereof. As the attention of the operator of an automotive vehicle must be directed primarily to the operation of a vehicle, such a need or impulse to locate visually a switch prior to actuation thereof detracts from the operator's attention which should otherwise be directed towards operation of the automotive vehicle.

What is needed, therefore, is an improved radiotelephone, and interface apparatus therefor, which facilitates usage of the radiotelephone by a user.

Summary of the Invention

The present invention, accordingly, provides a radio transceiver, and associated method, which overcomes the limitations associated with the existing art.

- 5 -

The present invention further advantageously provides a radiotelephone and an interface apparatus therefor which facilitates usage of the radiotelephone by a user while operating an automotive vehicle.

5 The present invention provides further advantages and features, the details of which will become more apparent by reading the detailed description of the preferred embodiments hereinbelow.

10 In accordance with the present invention, therefore, a radio transceiver, and associated method, operable by a user to communicate therethrough in a radio communication system is disclosed. The radio transceiver includes radio transceiver circuitry for generating modulated signals for transmission therefrom and for receiving modulated signals transmitted thereto. Control circuitry is coupled to the radio transceiver circuitry for generating control
15 signals including control signals which control operation of the radio transceiver circuitry. At least one input actuation element coupled to the control circuitry permits the user to input control commands to operate the control circuitry and, in turn, the radio transceiver circuitry. A visual-signal display assembly is comprised of a
20 projecting element coupled to receive control signals generated by the control circuitry and a screen element positioned beyond the projecting element for displaying visual signals projected thereupon by the projecting element.

25 Brief Description of the Drawings

The present invention will be better understood when read in light of the accompanying drawings in which:

30 FIG. 1 is a block diagram of a radiotelephone comprising the radio transceiver of a preferred embodiment of the present invention;

FIG. 2 is a partial block, partial schematic diagram of the radiotelephone, shown in block form in FIG. 1, positioned within the vehicular compartment of an automotive vehicle to permit operation

- 6 -

of the radiotelephone by a user during operation of the automotive vehicle;

5 FIG. 3 is a representation of a memory element comprising a directory which forms a portion of the radiotelephone shown in the preceding figures;

FIG. 4 is a representation of a single directory location of the directory represented in FIG. 3;

10 FIG. 5 is a plan view of a telephonic handset and a telephonic keypad forming a portion thereof according to a first preferred embodiment of the present invention;

FIG. 6 is a plan view, similar to that of FIG. 5, but of a telephonic handset and telephonic keypad thereof according to an alternate, preferred embodiment of the present invention;

15 FIG. 7 is a plan view, similar to those of FIGS. 5 and 6, but of a telephonic handset and telephonic keypad thereof according to another alternate, preferred embodiment of the present invention;

20 FIG. 8 is a partial block, partial schematic view of a visual-signal display assembly which forms a portion of the radiotelephone of the preferred embodiments of the preceding figures and a visual display generated thereby;

FIG. 9 is a partial block, partial schematic view of a visual display generated on a screen element of the visual-signal display assembly of FIG. 8;

25 FIG. 10 is a partial block, partial schematic view, similar to that of FIG. 9, but of an alternate visual display generated on the screen element of the visual-signal display assembly of FIG. 8;

30 FIG. 11 is a logical flow diagram of an algorithm executable by processing circuitry which comprises the control circuitry of the radiotelephone of the preferred embodiments of the preceding figures; and

FIG. 12 is a flow diagram listing the method steps of the method of a preferred embodiment of the present invention.

- 7 -

Description of the Preferred Embodiments

5 Referring first now to the block diagram of FIG. 1,
radiotelephone 100 comprising the radio transceiver of a preferred
embodiment of the present invention is shown. Radiotelephone 100
includes transceiver circuitry 106 formed of a transmitter circuitry
10 portion which generates modulated signals for transmission by the
radiotelephone and a receiver circuitry portion for receiving signals
transmitted to the radiotelephone.

Control circuitry 112 is coupled to transceiver circuitry 106 by
way of line 118 and is operative to generate control signals on line 118
to control operation of the transmitter and receiver circuitry portions
15 of transceiver circuitry 106. In the preferred embodiment of the
present invention, control circuitry 112 is comprised of a processor-
type device having software algorithms executable therein.

Input element 124 is coupled to control circuitry 112 by way of
line 130. Input element 124 includes a telephonic keypad comprised
20 of actuation switches as well as additional actuation switches which,
upon actuation thereof, cause input signals to be applied to control
circuitry 112.

Memory element 136 is also coupled to control circuitry 112,
here by way of line 142, to permit transfer of data between control
25 circuitry 112 and memory element 136.

Visual-signal display assembly 172, which includes projecting
element 178 and screen element 184 is also connected to control
circuitry 112, here by way of line 190. Control signals generated by
control circuitry 112 cause projecting element 178 to generate visual
30 signals which are displayed upon screen element 184. In a preferred
embodiment, visual-signal display 172 comprises a heads-up display.
Screen element 184 of assembly 172 is preferably transparent in
appearance.

- 8 -

Aural annunciator 193 is also coupled to control circuitry 112. Control signals generated by control circuitry 112 cause annunciator 193 to generate aural signals.

5 Paging-receiver circuitry 194 forms a further portion of radiotelephone 100 of a preferred embodiment of the present invention. Paging-receiver circuitry is coupled to control circuitry 112 by way of line 198. Control circuitry 112 is further operative to generate control signals on line 198 to control operation of paging-receiver circuitry 194.

10 A user of radiotelephone 100 initiates effectuation of communication therethrough by actuating selected ones of the actuation keys of input element 124 to provide thereby inputs to control circuitry 112. Control circuitry 112 is operative to access, if necessary, data stored in memory element 136 and to cause operation
15 of the transmitter and receiver circuit portions of transceiver circuitry 106. Control circuitry 112 is further operative to generate control signals on line 190, responsive to the input signals applied thereto on lines 118, 130, 142, or 198, to cause projecting element 184 of visual-signal display assembly 172 to generate visual signals for
20 display upon screen element 178 of display assembly 172. Control circuitry 112 is also further operative, if desired, to generate control signals, also responsive to the input signals applied thereto on lines 118, 130, 142, or 198, to cause aural annunciator 193 to generate aural signals.

25 When a signal transmitted to transceiver circuitry 106 is received by the receiver circuitry portion thereof, an indication of such reception is provided by transceiver circuitry 106 to control circuitry 112 by way of line 118. Control circuitry 112, responsive thereto, generates signals on lines 118, 190, 193 and 198, as
30 appropriate, to permit transceiver circuitry 106 to effectuate a two-way communication link with a remote site, to cause visual-signal display assembly 172 to generate a visual indication of the received signal, and to cause operation of paging-receiver circuitry 194, respectively.

- 9 -

When a signal transmitted to paging receiver circuitry 194 is received by such circuitry, an indication of such reception is provided by paging receiver circuitry 194 to control circuitry 112 by way of line 198. Control circuitry 112, responsive thereto, generates signals on lines 118, 142, 190, and 198, as appropriate to provide a user of radiotelephone 100 an indication of the received paging signal. In a preferred embodiment, when the paging receiver circuitry receives a signal transmitted thereto, and an indication of such reception is provided to control circuitry 112 by way of line 190, control circuitry generates a signal on line 190 to permit visual-signal display assembly 172 to display an indication of such reception upon screen element 184 thereof. Control circuitry 112 is also operative to access memory element 136 and to determine whether a telephone number forming a portion of a paging signal received by paging receiver circuitry 194 is also stored in memory element 136. If so, any information related to the telephone number (such as, and as shall be explained hereinbelow, mnemonic information related to the telephone number) is accessed by the control circuitry and thereafter also caused to be displayed upon screen element 184. Actuation by a user of actuation keys of input element 124 are further detected by control circuitry and, responsive thereto, the visual display upon screen element 184 is terminated.

The telephone number forming the portion of the paging signal received by paging receiver circuitry 194 may, of course, be supplied by control circuitry 112 to transceiver circuitry 106.

Turning next to the partial block, partial schematic diagram of FIG. 2, a portion of automotive vehicle 199 is shown. A radiotelephone, here referred to by reference numeral 200 and comprised of the elements contained within the rectangle shown in dash, is positioned within automotive vehicle 199. Circuitry portions of radiotelephone 200 analogous to transceiver and control circuitry 106 and 112 of radiotelephone 100 of FIG. 1 are housed within housing 220 which is supportively mounted within automotive vehicle 199. Radiotelephone 200 is further shown to include handset 222 upon

- 10 -

which is positioned input element 224 comprised of a telephonic keypad and also additional actuation switches. Handset 222, and more particularly, the actuation switches of input element 224 positioned thereupon is connected to the circuitry housed within housing 220 by way of line 230.

Screen element 278 and projecting element 284 which together comprise a visual-signal display assembly analogous to display assembly 172 of radiotelephone 100, are further shown to form a portion of radiotelephone 200. Projecting element 284 is coupled to circuitry housed within housing 220 by way of line 290.

Screen element 278 is positioned at a windshield portion of vehicle 199, and, in one embodiment, actually comprises a portion of the windshield. As element 278 is transparent in appearance, element 278 does not interfere with the view of an operator of the vehicle. When the visual-signal display assembly comprises a head-up display, and projecting element 284 is focused at an "infinity location," an operator of vehicle 199 may operate the vehicle and view information on the screen element 278 without refocusing.

A user of radiotelephone 200 initiates effectuation of telephonic communication by actuating desired ones of the actuation switches of input element 224 formed upon handset 222. Signals indicative of actuation of the desired switches is supplied to the circuitry of radiotelephone 200 housed within housing 220 by way of line 230. Control circuitry housed within housing 220 generates signals on line 290 to cause projecting element 284 to generate visual signals for display upon screen element 178. Visual signals displayed by projecting element 284 upon screen element 278 include visual signals which identify the status of the effectuation of a communication link with a remote site.

In a preferred embodiment of the present invention, a memory element, analogous to memory element 136 of radiotelephone 100 of FIG. 1, is housed within housing 220 to comprise an electronic directory for storing a series of telephone numbers which identify remote locations of a wireline telephonic network. Algorithms

- 11 -

executable by a processing element comprising control circuitry analogous to control circuitry 112 of radiotelephone 100 is operative to access elements comprising telephone numbers stored within the electronic directory.

5 Such an electronic directory facilitates usage of radiotelephone 200 by permitting a user of the radiotelephone to initiate effectuation of a communication link with a remote site while requiring the user of the radiotelephone to actuate a smaller number of actuation keys of input element 224. In a preferred embodiment, three actuation
10 switches, upon actuation thereof, cause control circuitry of radiotelephone 200 to access individual ones of the telephone numbers stored within the electronic directory.

FIG. 3 is a representation of a memory element comprising an electronic directory, referred to generally by reference numeral 336,
15 of a preferred embodiment of the present invention. Directory 336 is represented by an array formed of columns and rows wherein rows define subdirectory locations 338 (identified by letters A, B, C, D, ..., X, Y, Z) and columns 340 identify elements of individual ones of the subdirectory locations 338. The elements of each subdirectory
20 location 338 comprise telephone numbers which identify remote locations of a telephonic network. Preferably, each element of the subdirectory location includes a mnemonic identifier which identifies the telephone number associated therewith.

FIG. 4 is a representation of a single subdirectory 338 of directory 336 of FIG. 3. The illustrated subdirectory location
25 corresponds to the subdirectory location 338 identified by letter A of FIG. 3. The subdirectory location is comprised of a plurality of elements, each shown to include a telephone number and a mnemonic identifier associated therewith. When the algorithm
30 executable by processing circuitry comprising the control circuitry of radiotelephones 200 and 100 of the preceding figures is executed, the contents of a selected element of subdirectory location 338 is accessed by the control circuitry. The accessed telephone number of the selected element is provided to the transceiver circuitry of the

- 12 -

radiotelephone to be transmitted by the transmitter circuitry portion thereof, thereby to initiate effectuation of a communication link with a remote location identified by the accessed telephone number. The control circuitry of the radiotelephone further provides signals to the projecting element of the visual-signal display assembly of the radiotelephone which generates a visual signal of the accessed information upon a screen element. In such manner, a user of the radiotelephone is provided with a visual indication of the accessed telephone number and the mnemonic identifier associated therewith.

Telephone numbers stored within individual ones of the elements of subdirectory location 338 in FIG. 4 are each associated with a mnemonic identifier having a left-most letter A, here Aaron, Able, and Ayers. Other ones of the subdirectory locations 338 of directory 336 of FIG. 3 similarly include telephone numbers associated with mnemonic identifiers having other common left-most letters.

A user of radiotelephone 100 or 200, when desiring to initiate effectuation of a communication link with a remote location associated with a telephone number stored in directory 336, first accesses a desired subdirectory location 338 by actuating a first actuation key to sequence through the subdirectory locations 338 until a desired subdirectory location 338 is accessed. Then, a second actuation key is actuated to access individual ones of the elements of the selected subdirectory location. When a desired telephone number is accessed, the user of the radiotelephone actuates an additional key to cause transmission of the accessed telephone number to effectuate a communication link with a telephone associated therewith.

Because screen element 278 is positioned at a front windshield assembly of automotive vehicle 199, the user of radiotelephone 200, when positioned within automotive vehicle 199 is permitted to inspect visually the visual signal displayed upon the screen element 278 while operating the automotive vehicle 199 with little or no distraction. Elements of subdirectory locations 338 of directory 336

- 13 -

are visually displayed upon screen element 278 upon actuation by the user of radiotelephone 200 of the actuation keys which are operative to access the subdirectory locations 338 and individual elements thereof.

FIG. 5 is a plan view of handset assembly 422 which
5 corresponds to handset 222 of radiotelephone 200 of FIG. 2. As mentioned previously with respect to handset 222 of radiotelephone 200, an input element, here element 424 comprised of actuation keys contained within the rectangle shown in dash, permits a user to
10 input information to the circuitry of the radiotelephone to cause operation thereof. Here, input element 424 is shown to be comprised of a top portion formed of a telephonic keypad and also, at a bottom portion thereof, actuation keys 428 and 432. Actuation keys 428 and 432, when actuated by a user, permits access to various of the
15 subdirectory locations of an electronic memory forming a portion of a radiotelephone of the preferred embodiment of the present invention. With respect to directory 336 of FIG. 3, actuation of actuation key 432 causes an algorithm executable by circuitry of the radiotelephone including directory 336 to access successive ones of the subdirectory locations 338 in a consecutive manner. That is to say, successive
20 actuation of actuation key 432 causes sequencing through successive ones of the subdirectory locations 338. And, conversely, actuation of actuation key 428 causes accessing of inconsecutive ones of the subdirectory locations 338. By appropriate actuation of actuation keys 428 and 432, a user of a radiotelephone including handset 422 may
25 access a desired subdirectory location. Once a desired subdirectory location is accessed, a desired element thereof is accessed by actuation of another actuation key, here, for example, actuation key 436 of the telephonic keypad.

As illustrated, actuation keys 428 and 432 are of dissimilar
30 geometric configurations. Such dissimilar geometric configurations, once known to a user, facilitate identification of the actuation keys by tactile sensing of the locations of such keys by the user. In such manner, a user of handset 422 may advantageously locate the position of keys 428 and 432 without the need to look at the handset

- 14 -

422. Thereby, use of handset 422 when the user thereof is also operating an automotive vehicle is facilitated as the user need not visually inspect the handset 422 prior to accessing elements of selected directory locations.

5 Raised button 438 is further formed upon the numeric "five" actuation key. Raised button 438 also facilitates location of the actuation keys of handset 422 without the need to inspect visually such keys.

10 FIG. 6 is a plan view, similar to that of FIG. 4, but of a handset 522 of an alternate preferred embodiment of the present invention. Handset 522, similar to handset 422 of FIG. 4, includes an input element disposed thereupon, the input element here being referred to by reference numeral 524 and comprised of the actuation keys contained within the rectangle shown in dash. Actuation keys comprising input element 524 include a telephonic keypad as well as actuation keys 528 and 532. Actuation keys 528 and 532 are actuatable to perform functions analogous to the functions performed responsive to actuation of actuation keys 428 and 432 of handset 422 of FIG. 5. Also, actuation keys 528 and 532 are of dissimilar geometric configurations to facilitate tactile identification of such actuation keys by a user. Actuation keys 536 and 540 of input element 524 are also illustrated to be of unique geometric configurations which are different than the geometric configurations of the other actuation keys of the telephonic keypad of input element 524. Again, such unique geometric configuration facilitates tactile identification thereof by a user of handset 522. Actuation key 536 is actuatable to perform a function similar to that of actuation key 436 of handset 422. Raised button 538 is further formed upon the numeric "five" actuation key and is similar to raised button 438 of FIG. 5.

20 FIG. 7 is a plan view, similar to those of FIGS. 5 and 6, but of handset 622, of another, alternate preferred embodiment of the present invention. Handset 622 includes input element 624 comprised of the actuation keys contained within the rectangle shown in dash in the figure. Input element 624 once again includes

- 15 -

a telephonic keypad and additional actuation keys, here actuation keys 628 and 632. Actuation keys 628 and 632 are operative to perform functions similar to the functions performed upon actuation of actuation keys 428 and 432 and 528 and 532 of FIGS. 5 and 6.

5 Actuation keys 628 and 632 are of dissimilar geometric configurations to permit tactile identification thereof by a user of handset 622. And, actuation keys 636 and 640 of the telephonic keypad are also of unique geometric configurations, thereby also to permit tactile identification thereof by a user of handset 622. Raised button 638 is further formed
10 upon the numeric "five" actuation key and is similar to raised buttons 438 and 538 of FIGS. 5 and 6.

FIG. 8 is a partial block, partial schematic diagram of a visual-signal display assembly, here designated by reference numeral 772 and comprised of screen element 778 and projecting element 784.
15 Screen element 778 is mounted at front windshield assembly portion 788 of an automotive vehicle.

Signals generated by control circuitry (not shown in the figure) are provided to projecting element 784 by way of line 790. Responsive to such control signals, projecting element 784 generates visual
20 signals which are displayed upon screen element 778. Displayed upon screen element 778 of display assembly 772 are the contents of an element of a subdirectory location of an electronic directory such as directory 336 of FIG. 3.

FIGS. 9 and 10 are partial block, partial schematic diagrams of
25 screen element 778 which form portions of visual-signal display assembly of FIG. 8. In FIG. 9, the visual signal displayed upon screen element 778, "DIAL NUMBER", is representative of a visual-signal display generated responsive to actuation by the user of an actuation key of an input element of the radiotelephone. And, in FIG.
30 10, the visual signal displayed on upon screen element 778 is indicative of the status-indication of communication in a radio communication system during operation of a radiotelephone including screen element 778.

- 16 -

FIG. 11 is a logical flow diagram of an algorithm, referred to generally by reference numeral 800, executed by processing circuitry which comprises the control circuitry such as control circuitry 112 of radiotelephone 100 of FIG. 1, of the preferred embodiments of the present invention.

After entering into the algorithm, represented by start block 806, a determination is made, as indicated by decision block 812 as to whether a first actuation key has been actuated. The first actuation key selects subdirectory locations of an electronic directory, such as subdirectory locations 338 of directory 336 of FIG. 3. If not, the no branch is taken, and the algorithm awaits actuation of such actuation key.

If the first actuation key has been actuated, the yes branch is taken to block 818 and the first element of a first, successive subdirectory location is displayed upon a screen element. Then, a determination is made, as indicated by decision block 824, as to whether the displayed element contains the telephone number of the desired location with which communication is to be effectuated. If so, the yes branch is taken, and as indicated by block 830, a communication link is effectuated with the remote site associated with the displayed telephone number.

If not, the no branch is taken to decision block 836 and a determination is made as to whether a second actuation key has been actuated. The second actuation key selects successive elements of a single directory location of the subdirectory location selected responsive to actuation of the first actuation key. With respect to handset 422 of FIG. 5, the second actuation key comprises actuation key 436.

If the second actuation key has been actuated, the yes branch is taken to block 842 and the next element of the subdirectory location is displayed. Then, at decision block 848, a determination is made as to whether the displayed element contains the telephone number at the desired location with which communication is to be effectuated. If so, the yes branch is taken, and, as indicated by block 852, a

- 17 -

communication link is effectuated with the remote site associated with the displayed telephone number.

If not, the no branch is taken back to decision block 836.

5 If, at decision block 836, the second actuation key has not been actuated, the no branch is taken to decision block 860 whereat a determination is again made as to whether the first actuation key has been actuated. If so, a successive subdirectory location is accessed, and the first element of the accessed subdirectory location is displayed.

10 Thereafter, a determination is made, as indicated by decision block 872, as to whether the displayed element contains the telephone number of the desired location with which communication is to be effectuated. If so, the yes branch is taken, and as indicated by block 878, a communication link is effectuated with the remote site
15 associated with the displayed telephone number. If not, the no branch is taken, and the algorithm loops back once again to decision block 836.

If a determination is made at decision block 860 that the first actuation key has not been actuated, the no branch is taken to
20 decision block 884 whereat a determination is made as to whether a third actuation key has been actuated. Actuation of the third actuation key causes an inconsecutive one of the subdirectory locations to be accessed. With respect to handset 422 of FIG. 3, the third actuation key comprises actuation key 428. If the third
25 actuation key has not been actuated, the no branch is taken and the algorithm moves back to decision block 812. If the third actuation key has been actuated, the yes branch is taken from decision block 884 and the first element of the preceding subdirectory location, as indicated by block 890, is displayed. Then, as indicated by decision
30 block 894, a determination is made as to whether the displayed element displays the telephone number of the desired location with which communication is to be effectuated. If so, the yes branch is taken and, as indicated by block 898, a communication link is effectuated with the remote site associated with the displayed

- 18 -

telephone number. If not, the no branch is taken to decision block 836.

Finally turning now to the logical flow diagram of FIG. 12, the method steps of the method, referred to generally by reference numeral 1000, of the preferred embodiment of the present invention are listed. Method 1000 is for a radiotelephone having radio transceiver circuitry operable by a user to communicate therethrough in a cellular communication system.

First, and as indicated by block 1006, at least one input actuation element is coupled to the control circuitry to generate control signals including control signals to control operation of the radio transceiver circuitry.

Next, and as indicated by block 1012, at least one input actuation element is coupled to the control circuitry to permit the user to input control commands to operate the control circuitry and, in turn, the radio transceiver circuitry.

Finally, and as indicated by block 1018, a visual-signal display assembly comprised of a projecting element to receive control signals generated by the control circuitry and a screen element positioned beyond the projecting element for displaying visual signals projected thereupon by the projecting element is coupled to the control circuitry.

Because the handset upon which the input element of the radiotelephone of the preferred embodiments of the present invention includes actuation keys of dissimilarly-configured geometries, a user of the radiotelephone may identify the actuation keys by tactile sensing rather than requiring a visual inspection of the actuation keys, a user of a radiotelephone including such a handset may actuate desired actuation keys while operating an automotive vehicle. And, because a visual-signal display assembly including a screen element positioned at a front windshield assembly portion of an automotive vehicle displays information thereupon, the user of the radiotelephone may also visually inspect such display information with little distraction while also operating an automotive vehicle.

- 19 -

5 While the present invention has been described in connection with the preferred embodiment shown in the various figures, it is to be understood that other similar embodiments may be used and modifications and additions may be made to the described embodiments for performing the same function of the present invention without deviating therefrom. Therefore, the present invention should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the appended claims.

CLAIMS:

1. A vehicle radio telephone operable by a vehicle operator to communicate through a radio telephone communication system, comprising:

a transceiver circuit for transmitting and receiving modulated signals;

an operator actuated input device for inputting information, the operator actuated input device including a plurality of manually actuated keys and associated tactile identification such that the user can identify keys by touch;

a memory storing control signals;

a visual signal display including a projecting element for projecting an information image and a screen element to reflect the information image projected by the projecting element at a remote location for viewing by the operator; and

a control circuit coupled to the transceiver circuit, the input device, the memory, and the visual signal display, the control circuit responsive to control signals from the input device for generating control signals including control signals controlling operation of the transceiver circuit, the control circuit responsive to signals input by the input device to select control signals stored in the memory, and the control circuit controlling the projector to project information from the memory onto the screen such that the user can control operation of the transceiver using the input device and confirm the input operation by viewing the screen while operating the vehicle.

2. The radio telephone as defined in claim 21, wherein the input device includes a plurality of keys for entering information directly and a control keys for controlling access to information stored in the memory.

3. The transceiver as defined in claim 22, wherein the screen comprises a transparent element adapted to be mounted to a vehicle window in the operator's line of sight.

4. The transceiver as defined in claim 23, further including a pager receiver coupled to the control circuit, and wherein the control circuit is responsive to reception of a paging signal to control the projector to project paging messages to the screen.

5. The transceiver as defined in claim 24, wherein the transceiver circuitry includes cellular radiotelephone transceiver, and the input device includes a telephone handset keypad.

6. A method of controlling operation of a vehicle radio telephone using a keypad, the method comprising the steps of:

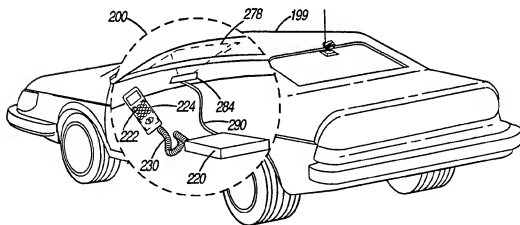
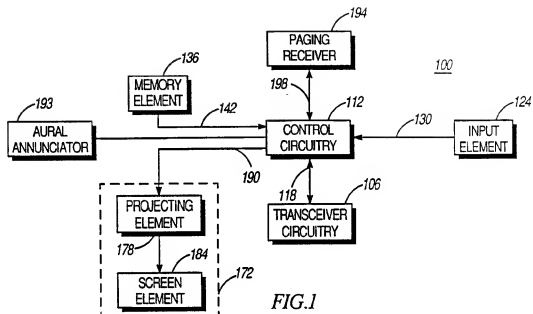
- storing information in a memory;
- accessing information stored in the memory using a keypad including tactile identification;
- projecting information accessed from the memory onto a screen; and
- controlling operation the radio telephone transceiver according to the information selected using the input device.

7. The method as defined in claim 26, further including the step of scrolling through information stored in the memory and displaying the information on the screen.

8. The method as defined in claim 27, further including the steps of displaying the information on a transparent screen mounted on a vehicle window.

9. The method as defined claim 28, further including the step of displaying messages received in a pager receiver on the display.

1 / 6



2 / 6

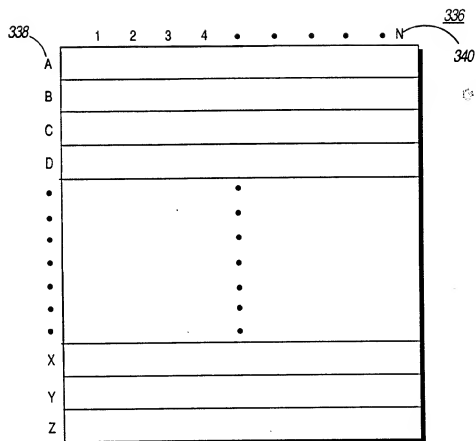


FIG. 3

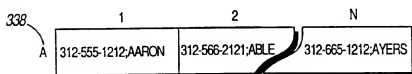


FIG. 4

3 / 6

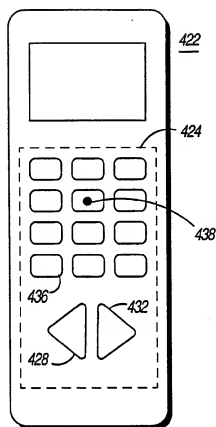


FIG. 5

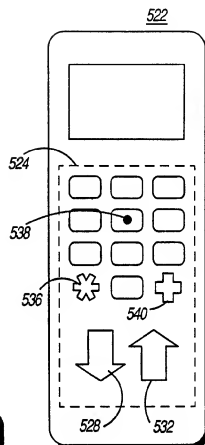


FIG. 6

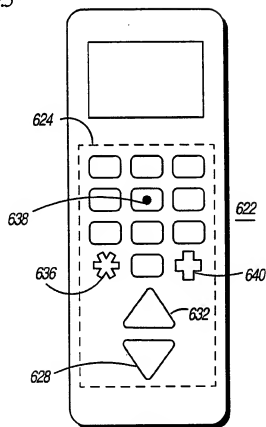
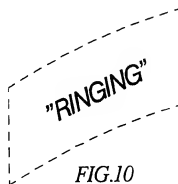
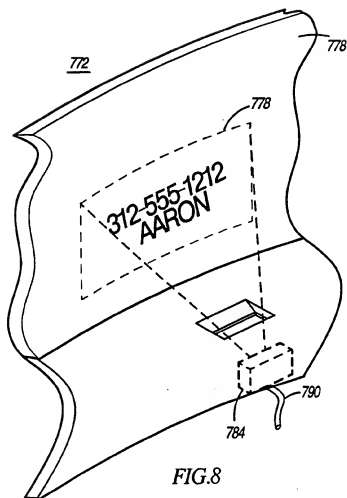
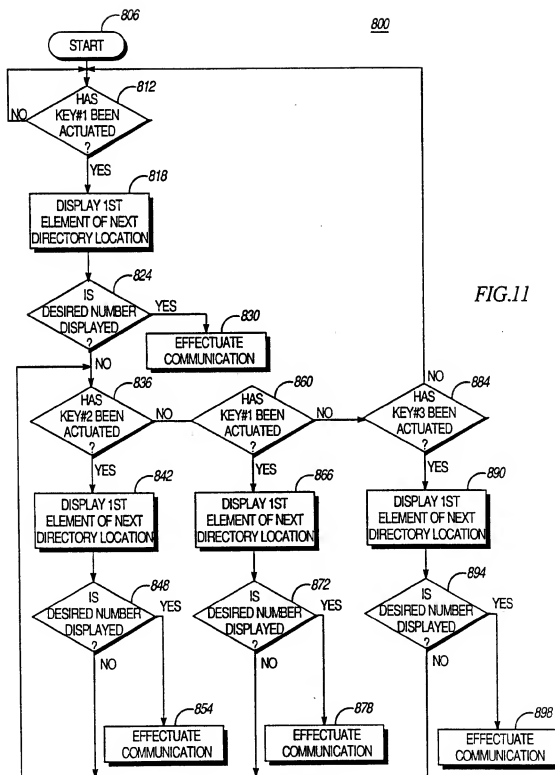


FIG. 7

4 / 6



5 / 6



6 / 6

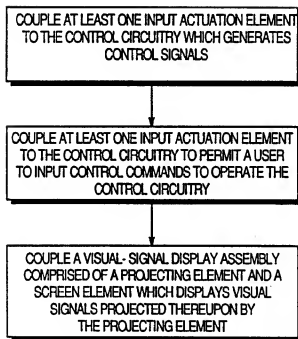


FIG.12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07011

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 11/00

US CL :379/59

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/59, 58, 63, 354, 355, 67, 88

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

search terms: display, projection, telephone, visual

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,885,762 (SUZUKI ET AL) 05 December 1989, see whole document.	1-2, 6-7
A	US, A, 4,852,146 (HATHCOCK ET AL) 25 July 1989, see whole document.	1-2, 6-7
A	US, A, 5,212,721 (DELUCA ET AL) 18 May 1993, see whole document.	1-2, 4-7
A	US, A, 5,216,705 (YOSHIDA ET AL) 01 June 1993, see whole document.	1-2, 6-7
Y	JP, A, 62-23266 (NUMATA) 13 January 1987, figure 1, pages 5-7.	1-2, 5-6
Y	JP, A, 05-37928 (HARAMOTO ET AL), 12 February 1993, figure 1, abstract.	1-4, 6-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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T

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document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

Z

document member of the same patent family

Date of the actual completion of the international search

12 OCTOBER 1994

Date of mailing of the international search report

NOV 07 1994

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07011

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,644,351 (ZABARSKY ET AL) 17 February 1987, col. 14, lines 25-50.	4, 7, 9